IRRIGATION AND DRAINAGE
Irrig. and Drain. **55**: 73–83 (2006)
Published online in Wiley InterScience (www.interscience.wiley.com). **DOI**: 10.1002/ird.217

MULTIFUNCTIONALITY OF AGRICULTURAL WATER: LOOKING BEYOND FOOD PRODUCTION AND ECOSYSTEM SERVICES[†,‡]

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ABSTRACT

The concept of multifunctional agriculture recognizes important potential benefits of agriculture in addition to the production of food: environmental services (wildlife habitat, pleasing landscape), food security, rural livelihoods and regional economic vitality, stable households and communities, cultural heritage and identity, and religious, spiritual, and aesthetic values. Agricultural water can also be considered through a multifunctional lens using the same logic, but also adding functions that are specific to water. Through this analysis, water becomes much more valuable than if it is considered as merely an input to agricultural production. Because paddy-based agriculture is based on water, an understanding of paddy's multifunctional nature helps to highlight the multifunctional nature of agricultural water. Four categories of functions are discussed: (1) economic and productive, (2) environmental, (3) sociocultural, and (4) rural development. Policy strategies for supporting these multiple functions are considered based on examples from Europe and Asia. The paper concludes with a discussion of water management and how the multiple functions of water can be incorporated into practical policies. Making wise decisions about water allocations to agriculture depends upon a sound understanding of the multiple benefits that agricultural water provides beyond the agriculture sector. While more research is needed, there is already a great deal of valuable research that has been carried out in the name of agriculture, and which can be applied to the challenges of understanding and managing agricultural water. Copyright © 2006 John Wiley & Sons, Ltd.

KEY WORDS: multifunctional agriculture; water management; cost-benefit analysis; rural policy

RÉSUMÉ

Le concept de l'agriculture multifonctionnelle met en évidence les importants bénéfices potentiels de l'agriculture au-delà de la production de nourriture: services environnementaux (habitat de la faune, paysage agréable), sécurité alimentaire, emplois ruraux et vitalité économique régionale, foyers et collectivités équilibrés, héritage et identité culturels, et valeurs religieuses, spirituelles et esthétiques. L'eau agricole peut aussi être analysée à travers un prisme multifonctionnel avec la même logique mais en ajoutant les fonctions spécifiques à l'eau. Avec cette analyse, la valeur de l'eau devient beaucoup plus élevée que celle d'un simple intrant dans la fonction de production. Parce que l'agriculture basée sur le paddy repose sur l'eau, la compréhension de la nature multifonctionnelle du paddy permet de mettre en lumière celle de l'eau. Quatre catégories de fonctions sont passées en revue: économique et productive, environnementale, socio-culturelle et développement rural. Les stratégies d'appui à ces fonctions multiples sont examinées à partir d'exemples en Europe et en Asie. L'article conclut en abordant la gestion de l'eau et la façon dont les fonctions multiples de l'eau peuvent être incorporées dans les politiques concrètes. La détermination raisonnable de la proportion d'eau agricole dépend de la compréhension en profondeur des bénéfices multiples qu'elle fournit bien au-delà du secteur agricole. Si d'autres

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[†] Multifonctionnalité de l'eau agricole: au delà des besoins de la production alimentaire et de l'environnement.
[‡] Prepared for the FAO/Netherlands International Conference on Water for Food and Ecosystems, The Hague, Jan. 31–Feb. 5, 2005.

Received 2 February 2005
Revised 25 August 2005
Accepted 31 October 2005

efforts sont nécessaires, il existe déjà un grand nombre de recherches de grande valeur dans le secteur de l'agriculture qui peuvent être appliquées aux défis que sont la compréhension et la gestion de l'eau agricole. Copyright © 2006 John Wiley & Sons, Ltd.

MOTS CLÉS: agriculture multifonctionnelle; gestion de l'eau; analyse coût-bénéfice; politique rurale

INTRODUCTION

A great deal has been written in the past few years about the multifunctionality of agriculture, particularly in the context of the European Union where a common agricultural policy has been negotiated by member states. Briefly stated, the concept of multifunctional agriculture recognizes important potential benefits of agriculture in addition to the production of food. The most important class of additional benefits is that of environmental services: providing habitat for wildlife, and a desirable landscape for humans, especially urban ones who now place extra value on reminders of the life they have left behind. Important as the positive environmental externalities can be (and by implication, the negative externalities can also be severe, depending on the type of agriculture being practiced), there are also many other functions of agriculture: food security, rural livelihoods and regional economic vitality, stable households and communities, cultural heritage and identity, and religious, spiritual, and aesthetic values.

Which functions are included under the multifunctionality concept, and the relative importance placed on them, reflect the cultural values of the observer. This intrinsically subjective nature of the concept, and the need to harmonize the discordant agricultural policies of the European Union countries into a common agricultural policy, has resulted in a wealth of studies, reports, and analyses about the multifunctionality of agriculture.

This paper seeks to harness some of these intellectual investments to shed light on a closely related, but surprisingly neglected topic: the multifunctional character of agricultural water. The logic of multifunctional agriculture applies equally to agricultural water, and in addition, there are special functions that derive from the water itself (e.g. flood control, swimming, bathing). By viewing irrigation water through multifunctional lenses, and adding up the various values it provides, the economics of irrigation look much more attractive. When irrigation is considered along with the agricultural system which it supports, the assemblage of potential benefits becomes even more impressive.

The organization of this paper is in four parts. Part 1 presents an overview of the multifunctional agriculture concept, especially as defined in Europe and Japan, where it is a significant factor in agricultural policies. Part 2 explores the multifunctional character of water through the example of irrigated paddy cultivation in monsoon Asia. Part 3 discusses how policies and programs can provide support to agriculture's multiple functions. Part 4 presents conclusions about the importance of the multifunctionality concept to the challenges of water management.

1. OVERVIEW OF THE MULTIFUNCTIONALITY CONCEPT

Multifunctionality, as a defining theme for agricultural policies, is mostly an Old World phenomenon. It is the established, indigenous, and wealthy nations of Europe and Asia where the concept finds support from both governments and civil society. These countries are redefining the very notion of agricultural development to reflect their societies' renewed appreciation for their cultural and environmental heritage. The increasing interest in the multifunctional dimensions of agriculture in Europe and Asia is not shared by the New World nations of the United States, Canada, and Australia where agricultural policies continue to focus on intensive commodity production through increasingly industrial production processes. These countries tend to regard the multifunctional perspective of Europe and Asia as a thinlydisguised justification for agricultural subsidies.

Caught in the middle of these two views are the developing countries who are fearful of any agricultural subsidies that will threaten their own agricultural exports, yet who also have the most to lose in terms of their still largely intact agrarian societies. The multifunctional path offers them a new paradigm of agricultural development that does not sacrifice the agrarian backbone of their society. With the exception of some Latin American countries, however, the developing world tends to view multifunctionality with the same skepticism with which they viewed environmental conservation a decade ago: as a concern of the wealthy nations. It is easy for the wealthy countries

to place a new value on their few remaining forests; it is another matter for developing countries to forgo the short-term economic boost offered by unsustainable exploitation of their renewable natural resources. The challenge for proponents of multifunctional agriculture is to demonstrate its realistic feasibility for developing countries.

Origins of multifunctionality

National policies that have long recognized agriculture's special role in society, either in terms of food security (particularly in the aftermath of the Second World War) or more recently, in maintaining environmental features of the landscape. But the ideas on which multifunctionality is based–that industrial agricultural modes of production are not a desirable future for society–have much deeper roots. Indigenous and ethnic minorities throughout the world have long insisted that their agricultural practices are key elements of their cultural and religious identity. Back-to-nature movements within some of the developed countries seek to reestablish an agriculture based on a spiritual relationship between the farmer and the earth. Consumer-oriented movements, such as Italy's Slow Food initiative, also promote agricultural values that go beyond economics.

Against this backdrop of agricultural traditions and innovation, the concept of multifunctionality was officially born at the 1992 Earth Summit in Rio, where the term is used in Agenda 21 to describe the potential for positive environmental benefits from ecofriendly agriculture. This environmental heritage of the multifunctionality concept can be seen in the 1999 FAO-Netherlands conference held in Maastricht. The title of that conference was ''Taking Stock of the Multifunctional Character of Agriculture and Land'' with the objective to ''identify new practices and the necessary enabling environments that will lead to increased agricultural sustainability''.

Multifunctionality in Europe

The current meaning of multifunctional agriculture has been defined in Europe, both by the OECD (1998) in their initial report of 1998 and in the ''European model of agriculture'' introduced into the Common Agricultural Policy with the Agenda 2000 reform. In the words of Laurent Van Depoele, former Director at the European Commission (www.teagasc.ie):

> The European Model of Agriculture (EMA) became the cornerstone of the EU agricultural policy in the European Council in Luxembourg in 1997. It is a policy statement about the unity between society, landscape and agriculture, which has become an important tool, rather than a new normative framework, for agriculture and rural policies in the future. It is closely linked with the concepts of the multifunctional character of agriculture, of sustainable agriculture and of multisectoral rural development.
>
> European agriculture also delivers public goods, that is to say, it preserves and protects the rural landscape and environment and sustains rural areas. Some WTO partners may regard the EMA as a way to further defend agriculture subsidies, or as ''window-dressing''. The main concern of the Agricultural Ministers was however to prove the usefulness of agriculture to society and to ensure the willingness of the society to support European Agriculture.

Multifunctionality in Japan

At the same time that the European Union was establishing multifunctionality as a central feature of the European Model of Agriculture, an independent and parallel process was taking place in Japan. The Basic Law on Food, Agriculture, and Rural Areas (1999) notes that agricultural lands not only ''function as places for food production, living and resting, they also fulfill a variety of other roles and multifunctionality. The lush forests and rice fields that spread throughout help to preserve our land and natural environment and offer us green and beautiful landscape''. Agricultural policies in Japan are oriented toward preserving this landscape in the face of an ageing farm population and migration to urban.

The meanings of multifunctionality

There has been a gradual expansion of the meaning of multifunctionality. In Europe, the current meaning includes food security, food safety, animal welfare, cultural landscape, biodiversity and rural development

(Glebe, 2003). The term ''cultural landscape'' can cover an array of issues, including visual aesthetics, cultural identity attached to certain farming practices, and the cultural importance of particular foods. In the Asian context of monsoon paddy cultivation, there is the additional feature of water in the visual landscape and a greater emphasis on the dimensions of harmony and spiritual well-being that the landscape induces. The precise meaning of multifunctionality needs to be defined in a local context. For example, the functions of rice cultivation in Bali, Indonesia, include religious observances and community social structure–dimensions of life that are perhaps less relevant to European farmers. (The case of Bali is discussed below in greater detail.)

Emerging trends

In Europe, multifunctionality is contributing to a broad discourse about the nature of development and the future character of rural life in a ''post-productive'' society. In the words of Professor Geoff Wilson (2004) ''Only by contextualising multifunctionality in the context of the transition from productivism to post-productivism will it be possible, first, to understand the concept of a multifunctional agricultural regime, and, second, to anchor the notion of multifunctionality theoretically in the context of agricultural change.'' There is an ongoing process of societal soul-searching which is being stimulated by both social academics and environmental activists who see an opportunity for using the logic of multifunctionality to challenge conventional assumptions about the future direction of social and technical progress.[1]

In Asia, multifunctionality has been incorporated into the agricultural policies of Japan but remains outside official policy in other countries of the region. Thus far, proponents of multifunctionality remain in the research mode, studying the concept and proposing indicators that can eventually support policy measures.

2. MULTIFUNCTIONAL DIMENSIONS OF PADDY CULTIVATION IN MONSOON ASIA

In monsoon Asia, paddy cultivation has been the basis for economic life, as well as social and cultural life, for several thousands of years. Today it continues to be the dominant agricultural activity in Southeast Asia, and also the major consumer of water. While paddy can grow in very high rainfall zones, the natural rainfall is normally supplemented by irrigation water which is distributed through sophisticated networks of canals and water control structures. Paddy cultivation alone accounts for nearly as much water consumption as all other uses combined–including nonpaddy agriculture plus municipal and industrial uses. The infrastructure that captures and distributes the water is expensive–either in terms of local labor (for traditional community-managed irrigation systems) or in terms of development capital (for state-managed schemes). During the 1980s it was reported that Thailand expended 25% of its total budget on irrigation infrastructure. What does society receive in return for these massive investments? The accounting of the benefits from paddy cultivation only makes economic sense in a multi-functional context.

Countries in the monsoon region of Asia have a long history of collective, small-scale paddy cultivation. A typical rural landscape is that of paddy fields stretching as far as the eye can see, or terraced paddy fields on mountain slopes. This peaceful appearance masks a great deal of hard labor inputs for irrigation and drainage facilities, terrace construction, land preparation, planting, harvesting, threshing, etc. The unique social requirements of cooperative labor and synchronized cropping patterns (to share the water and combat pests) have resulted in strong village-level political organizations and mechanisms for cooperation at larger levels within the watershed.

Is the spirit of cooperation and shared values an outmoded legacy of the past which must give way to monetary calculations of productivity and profit? Or can cooperation among rural communities be enhanced and extended even to the urban population who desire traditional foods and appreciate the traditional landscape of paddy fields? As the traditional landscape has become increasingly threatened by urban encroachment, many countries of monsoon Asia are taking stock of the role that paddy cultivation plays in the totality of their social, cultural, spiritual, economic, and ecological well-being.

The starting point for considering the multiple roles of paddy cultivation is the integration of paddy cultivation with traditional rural society, and the integration of those traditional values into the modern and increasingly urban culture of Southeast Asian countries. Paddy cultivation, and the water that makes that cultivation possible, is

an integral dimension of the cultural values that give meaning to people's lives. An overview of the various ways that paddy cultivation can be seen as beneficial is outlined below in terms of four broad categories: (1) economic and productive functions, (2) environmental functions, and (3) sociocultural functions and (4) rural development functions.[2]

Economic and productive functions

Rice production is, of course, the primary function of paddy cultivation, and the primary user of irrigation water. In China, more than 50% of the total water supply for agriculture is used for paddy rice (1995 figures cited in Huaung, 2002). Average rice yields will need to increase from the present 6.3 t/ha^{-1} to 9.3 t ha^{-1} assuming self-sufficiency within the existing sown area, while total agricultural water use will need to remain constant because of strong demands from other sectors. New technologies are anticipated as the only solution to these constraints, including improved on-farm irrigation practices, new and higher-yielding rice varieties, and land consolidation to create larger farms that can be more easily mechanized (Huaung, 2002, p. 129).

In Malaysia, recent policies have focused on rice production in eight large irrigated Granary Areas totaling 212 000 ha. These areas have received technical and management interventions aimed at improved water control for increased rice productivity (Abdullah, 2002) Paddy cultivation outside these areas will be phased out in favor of more remunerative cash crops, fruit orchards (papayas, starfruit, mangoes, etc.) and industrial tree-crops (oil palm, cocoa, etc.), and aquaculture. Within the Granary Areas, recognition is given to broad-based rural development stimulated by the increased rice production. The multiple functions of paddy cultivation, however, are not considered sufficiently important to overcome the relatively poor economics of rice production in small-scale irrigation systems outside the designated Granary Areas.

In Myanmar, surplus rice production is an important national objective, to ensure food security and to generate export revenues (U Kyaw, 2002). The policy focus is on enhancing agricultural production in general, and paddy production in particular. The primary input besides land, is water, with 90% of harnessed water used for agriculture. A key priority within the agricultural water sector is the more efficient use of water through on-farm improvements and water management training.

A focus on water-saving measures is important to every country where water is a limiting input. In China, a great deal of research has gone into ''water-saving irrigation'' (WSI) techniques of rice production which allow rice to attain its full biological potential with far less water inputs (Feng and Li, 2002). These practices result in ''real'' water savings and have deep impacts on water circulation, rural economy, food security, labor allocation, and the environment. Given the right conditions, WSI rice can be significantly more profitable than conventionally grown rice, allowing paddy farmers to meet the increased competition from global markets.

Thailand produces rice for itself and for much of the world; nearly 40% of international rice trade comes from Thailand. The current focus of agricultural policy is to reduce the vulnerability to over-supply conditions through diversification to nonrice crops.

However, the same conditions that contribute to Thailand's comparative advantage in rice production–ranging from farmer knowledge and attitudes to the design of irrigation systems built for paddy–pose challenges when applied to nonpaddy crops (Jesda, 2002).

The economic value of paddy fields is not always limited to rice production, or to offseason dryland crops, but is also due to the raising of fish and ducks. Fish living in the paddies eat rice pests (algae and insects), while producing nutrients for the rice, and protein (or cash) for the farm family. Ducks have a similar function and produce enough meat to compensate for any fish that they might eat as well. Rice–fish–duck culture can increase rice production (up to 30–35%) while providing farmers with improved nutrition, extra income, and reduced application of fertilizers and pesticides (Abdullah, 2002). Aquaculture in irrigation reservoirs is also important, particularly in small village-owned tanks such as those in Sri Lanka (Dharmasena, 2002).

Environmental functions

Paddy fields comprise an artificial environment that operates in concert with the natural environment. Rather than having an ''impact'' on the environment, paddy fields become part of a new environment with ecological

processes that reflect the influences of both man and nature. Do paddy fields ''consume'' water, or merely divert some of the riverine flows onto the land (paddy fields) where the water cascades from field to field until reentering the river downstream? Many of the water control features of paddy field irrigation have direct economic value: flood prevention, groundwater recharge, prevention of soil erosion and landslides, and water and air purification. The economic values of these environmental services are difficult to assess, since there is no standard methodology for doing so. Estimates of the value of only the flood prevention services of paddy cultivation in Japan, range from US$16 billion to 24 billion; two different studies of the value of paddy-related water purification in South Korea give estimates of US$1 billion and 5 billion (Kwun, 2002).

Habitat value. The biological function of the paddy landscape lies in the wetland habitat it provides to animal and plant forms. These habitats have importance for ecosystem health and biodiversity both locally and for the global ecosystem through migratory birds (e.g. cranes) and insects.

Eco-tourism. One potential way of harnessing the landscape for economic purposes is through ecotourism. In Bali, rural hotels located in the midst of paddy lands use this as a feature to attract tourists, and arrange farm visits for the guests. While such cases are still unusual, the phenomenon of agricultural tourism is growing in many countries.

Sociocultural and religious functions

Throughout the rice-producing regions of Southeast Asia, the integration of paddy cultivation and local cultures has been evolving for thousands of years. Religious rituals and cultural identity are tied to the rice cycle. In Bali, the indigenous associations of rice irrigators sharing water from a common source (*subak*) serve as religious and social communities as well as a productive unit (Sutawan, 2002). Balinese culture cannot be separated from the *subaks*, and from the daily activities that rice production entails. The basic philosophy of life for Balinese people (*Tri Hita Karana*) emphasizes the importance of maintaining harmony in the world. This THK principle serves as a basis for paddy cultivation, while at the same time, the cycle of paddy cultivation provides an expression and affirmation to the THK principle. The *subak* rituals are carried out regularly, following the states of rice growth and the sequence of rice farming activities. *Subak* rituals play an important role in developing awareness among farmers that water as a gift from God should be used fairly for the benefit of all.

Landscape value. Many people, both urban and rural, enjoy the scenery of paddy fields (and other forms of agriculture) and may be willing to pay for this experience (Nakashima and Kinoshita, 2002). The visual benefits of the landscape are easy to experience (by driving, or in the compact urban setting of Japan, even by walking) into the countryside. The universality of access to visual benefits offers a special place to the landscape function of agriculture. As is the case in many European countries, Korea has instituted direct payments to farmers for maintaining the agricultural landscape, in this case levees of their paddy fields. This is seen as both an aesthetic measure and to provide adequate flood water storage (Lim, 2003).

Cultural heritage. Paddy cultivation is a living heritage which refers to tradition and reaffirms that heritage in the present. The significant components of that heritage may include the visual landscape (overlapping with the category of ''landscape value''): the architecture of rural buildings, the irregular bunds marking the borders of the paddy fields, the irrigation channels themselves, and the fields themselves with paddy growing, or the empty fields between crops. Culture heritage also has less visible and invisible components: particular varieties of rice which have cultural meaning, as well as nutritional and culinary significance; the knowledge of the consumer that the rice has been cultivated in a particular way, and in a particular place that has meaning (and may be reflected very directly in the price of that variety); even the consumers' knowledge that by purchasing this particular rice, they are supporting farmers who are maintaining agricultural traditions.

Aesthetics. Aesthetic values can overlie the values of cultural heritage, landscape, and even religion. As artists and art critics can attest, there is an aesthetic aspect to viewing not only art, but the world at large. The human

appreciation of the spacious, tranquil verdant landscape is an expression of aesthetic values. So too is the appreciation of the particular flavor or aroma, or appearance of a particular rice variety, or rice preparation made from that variety. The pleasure that an urban-dwelling Japanese businessman experiences upon viewing a traditional farmhouse derives from a combination of cultural and aesthetic values. The appreciation that underlies a consumer's willingness to pay a high price for a particular variety of rice may derive partly from an appreciation of the aesthetics of the cultivation process–knowing that it was produced on a small farm without using pesticides and in harmony with nature, etc.

Rural development functions

The rural development benefits of paddy cultivation (and agriculture in general) go far beyond the primary crop production activity. It affects almost all sectors of the economy. The development strategies of many SE Asian countries have used rice-based agriculture as the cornerstone of broad-based economic growth. For example, in Malaysia's Muda irrigation scheme (100 000 ha) investments in improved water management and cultivation practices resulted in higher farm income (from double cropping and higher yields) providing farmers with more disposable income, which in turn stimulated retail trade, service industries, and so on (Abdullah, 2002). The rice-based agricultural economy in this case, is the engine that drives other sectors of the rural economy. In Sri Lanka, a settlement strategy has been adopted to slow urban growth through enhanced economic opportunities in rural areas. Irrigation development, including both paddy and nonpaddy crops, provides continuous production opportunities, thus allowing farm families to earn a viable income and remain on the farm (Dharmasena, 2002).

Social capital and decentralized governance. Traditionally, small-scale paddy-based irrigation systems were built and managed by the farmers themselves. Today, participatory management of local irrigation systems is an important trend as a way of improving management and reducing operating costs. A multifunctional aspect of this approach is the strengthening of social capital that participatory irrigation management stimulates. The skills and experience that farmers gain through the cooperative management of their irrigation system can be applied to other entrepreneurial endeavors and thereby contribute to broad-based rural development. At the same time, the farmers who are collectively participating in managing their irrigation systems derive a sense of satisfaction and well-being from the participatory process itself.[3] The phenomenon of participatory management is equally relevant to small systems, which may be entirely under the management of local water user associations, and government-run large-scale irrigation systems, where the lower sections are managed by water user associations.

In nearly all countries of Southeast Asia, these local-level irrigation institutions are an important feature of decentralized governance and contribute to the capacity and viability of local levels of government. In Vietnam, an ongoing government program builds the capacity of agricultural cooperatives and then transfers to them the responsibility for managing irrigation schemes that had been under state control (Ha Luong, 2002). In the Philippines, the government has actively promoted joint management between water user associations and the National Irrigation Administration, and is gradually transferring more management authority to the associations (Pascua, 2002). In Japan, the institution of the Land Improvement District (LID) is a well-established part of rural management: farmers sharing a common irrigation source petition the government to establish a legal entity which has the authority to operate and maintain the irrigation facilities on which they depend (Taniyama, 2002). In this process of irrigation management transfer, the farmers are becoming more than ''farmers'' cultivating paddy and other crops; they are becoming the managers of public assets (the irrigation canals, small dams, and other water control structures) and public water resources.[4]

Multifunctional water user associations. Water user associations–whether traditional (e.g. Balinese *subaks*), or newly established through government programs (as in Vietnam and the Philippines)–serve functions of local governance, and can themselves serve multiple functions. In addition to their primary role of irrigation management, some *subaks* in Bali, for example, have started business enterprises such as seed certification farming, tractor leasing, and money lending. Bulk purchase of agro-inputs, and group marketing arrangements are other ways that the organizational structure of the *subak* can give extra value over and above water management (Sutawan, 2002).

In the Philippines, some of the water user associations are also becoming involved in upstream watershed protection and reforestation (Pascua, 2002).

Multifunctional interactions

The multifunctional benefits of paddy agriculture combine to give a total value that is far greater than the raw value of production would suggest. However, we cannot simply addup all the benefits to a grand total value. Some functions preclude other functions, while in other cases, synergies can be found. The rural development multiplier effects from irrigation systems, for example, lie at the heart of rural economic strategies in Asia dating back to the early days of international development assistance in the 1950s and 1960s. Irrigation systems support both paddy and nonpaddy production that in turn stimulates rural enterprises and serves as the engine of growth for the rural as well as urban-industrial sectors.

These economic lessons were learned too well: the enthusiasm with which development planners embraced large-scale, industrial agriculture did indeed stimulate Asian economies, but at the price of eroding many of agriculture's multifunctional services (environmental, social, cultural). Since these services were not part of the accounting system, they were forgotten, or deemed irrelevant to modern agriculture and consciously left out of the equations. Polluted aquifers from pesticide runoff? A necessary consequence of progress was the quick response. Displaced families forced into lowpaying factory jobs? They are entering the economy of the future. The multifunctional services we are starting to appreciate now would have been viewed as romantic idealism that has no place in the modern world (and indeed, these views are still widespread).

A positive spiral of multifunctional synergies can also be imagined with more ecological approaches to agriculture. Environmentally friendly agricultural development is the path that Bali followed prior to the investments of foreign aid agencies. Throughout the era of large-scale development projects in Asia there have been small-scale initiatives to promote high productivity agriculture that enhances the multifunctional benefits of agriculture. Just as environment and development do not need to be in conflict, so too agricultural productivity can coexist with, and add value to, the environmental, social, and cultural dimensions of rural life.

3. HOW TO SUPPORT MULTIFUNCTIONAL AGRICULTURE

The first step in designing policies to support the multiple functions of agriculture is to establish the policy intent to do so. This step implies a policy debate not only within the government, but within the larger civil society, as to the desirable role of agriculture within that society. In the case of Europe, the necessity of formulating a common policy stimulated a far-reaching debate about the functions of agriculture that is still continuing. The need to clarify agricultural policy has in turn fed a broader debate about the future of rural society and rural landscapes.[5] In Japan, the impetus for policies supporting multifunctional agriculture comes from the domestic farm lobby, and is given added urgency by the need to justify these policies to agricultural trading partners (e.g. the United States) who object to agricultural subsidies, even multifunctional ones.

Japan is broadening the discussion to other countries of the region through the creation of a regional network to examine multifunctionality of paddy agriculture. The International Network for Water and Ecosystem in Paddy Fields (INWEPF), which grew out of the 3rd World Water Forum in Kyoto (March 2003) aims to ''create a flexible platform which offers opportunities to exchange and share information about water use and multifunctionality in paddy fields, and strengthen partnerships among governments, international organizations, and NGOs'' (INWEPF, 2004). In contrast to the EU policy debates, the INWEPF network is numerically dominated by the developing countries of the region. It will be interesting to see whether and how their policies will incorporate the issues of multifunctionality which up to now have been primarily a concern of Japan and Korea.

Once the policy decision is taken to promote multiple functions of agriculture, what practical measures can accomplish this? Conventional market mechanisms are not adequate. In order to support the multifunctional services of agriculture, either the markets need to change, or governments must intervene. Interventions are needed at four basic levels:

1. Support to the farmer
2. Support to the rural communities
3. Support to the rural area
4. Support to the sector

Support to individual farmers

Incentives can be directed to farmers to pursue certain types of production regimes that will enhance multifunctional objectives. Under France's Agricultural Orientation Law, individual farmers can enter into ''rural farming contracts'' (*contrats territoriaux d'exploitation*) The farmer would offer a proposal to: (a) create added value through quality improvement of products, farming diversification and/or creating jobs, and (b) promote improved land management (including water, grasslands, biodiversity, landscapes, etc.). In Japan and Korea, farmers receive direct payments to maintain paddy terraces in mountainous areas, where flood control is of particular concern.

Support to rural communities

Regional plans promoting multifunctional agriculture blend participatory processes of community involvement with outcomes that create rural amenities as well as jobs. Under Germany's Sustainable Development Strategy, the Regional Action Program elicits proposals from the regions for synergies among agriculture, environment, and rural livelihoods. Examples include (1) grassland management that enhances economic competitiveness as well as landscape aesthetics, and (2) measures to improve landscape and develop renewable energy and in turn develops local expertise in these businesses. The region's reputation for this business is leveraged by agricultural producers marketing their goods under a common regional brand name (Knickel and Peter, 2004).

Support to the rural area

Conventional rural development has emphasized a range of infrastructure (roads, markets, communications, storage facilities, etc.) and services (water supply, schools, medical clinics) aimed at agricultural growth and stable populations. A similar approach can also serve the interests of multifunctional agriculture, particularly if combined with supportive policies and extension (as discussed below). The education system is perhaps the most critical component of the rural amenities. Providing local students with the knowledge and skills needed for multifunctional agriculture requires more practical curricula and perhaps novel teaching methods.

Support to the agriculture sector

Conventional monofunctional agriculture is supported by a vast research and extension network that would need to be reformed to meet the needs of ecologically oriented agriculture. Decentralized, location-specific, farmer-led research would become relatively more important for multifunctional approaches.

4. CONCLUSIONS: APPLYING MULTIFUNCTIONALITY TO WATER MANAGEMENT

The multifunctionality concept serves as a guide to agricultural policies that are in the long-term interest of society. Basically the concept offers a broader context, besides economic profitability or crop productivity, for selecting among agricultural options. When the logic is followed, the result is likely to be a more eco-oriented agriculture that has long-term sustainability, and supports the social and cultural values of society.

Can the concept also be applied to water management? Debates about water policies often focus on whether water is purely an economic good or whether it is also a social good. Should water be priced on economic criteria alone, or should irrigation water be priced more cheaply so that farmers can afford to stay in business? The multifunctionality perspective approaches this issue from a different set of assumptions. Water for agriculture is

assumed to have multiple functions, many of which are outside of market forces. There is no question of treating agricultural water as a purely economic good, because it is not one. Agricultural water provides a range of services to society, of which food production is one. Other functions include the same list that applies to agriculture (environmental, social, cultural) plus the multifunctional uses of the water itself: drinking, bathing, washing, recreation, aesthetic, spiritual, cultural, etc.

The discussion (above) of paddy cultivation in monsoon Asia illustrates the many complex functions of agricultural water. The irrigation water for the *subaks* in Bali originates in a sacred lake. The water continues to be sacred as it flows down the river and is diverted into the paddy fields. It is also beautiful (aesthetic) and culturally meaningful. And it is used for practical purposes of bathing and drinking and washing. And it provides habitat for wildlife, ducks, fish, etc. And of course it also irrigates the rice plants. The *subak* system of diversion structures and channels provides a physical structure to the social structure of the *subak* community, which crosscuts village lines providing an additional set of community ties, social networks, and local governance. What is the value of this social capital which is based on agricultural water?

Similar multifunctional dynamics can be found in many parts of the world, and not only in monsoon Asia. In my own region, for example, the traditional Spanish-derived *acequia* irrigation systems along the upper Rio Grande River exhibit a distinctive culture that is closely tied to the system of irrigated agriculture (Groenfeldt, 2004). The crop production of these systems is highly valued by urban consumers, but the agriculture itself is not very profitable. The water used in agriculture has a far higher economic value when transferred to urban development (a process which appears inevitable). Yet when the multiple functions of irrigated *acequia* agriculture are considered, including the tourism attracted by these traditional farms and landscapes, society might well prefer agriculture over further urban development.

Making wise decisions about water allocations to agriculture depends upon a full accounting of the multiple functions of agricultural water. Identifying the functions to be included in the accounting system is a culturally subjective process. Indeed, that is precisely the problem. The subjectivity of conventional analysis gave too much weight to market economics, and ignored the externalities. The analysis needed now is much more complicated, and much more interesting. It needs to include cultural, social, and environmental functions, and the analysis needs to be grounded in a clear vision of rural development and the role of agriculture in society.

To conclude that ''more research needs to be done'' is certainly an understatement, but a great deal of work has already been carried out, particularly in Europe. The challenge now is to take the debate about the multi-functionality of agriculture, and of agricultural water, to the developing world where the economics of ecoagriculture are more critical than in the wealthier North. The concept of multifunctionality has the potential to spark a fresh, and long overdue, debate about the future of rural areas in general and agriculture in particular.

NOTES

1. An influential report by the European office of WWF, entitled *Rural Development in an Enlarging European Union* (2002), is an example of this trend.
2. The information outlined in this section is mostly taken from a workshop on *Multi-Functional Roles of Paddy Field Irrigation in the Asia Monsoon Region* held in Otsu, Shiga, Japan, 20–21 March 2002, organized by the Japanese Society of Irrigation, Drainage and Reclamation Engineering (JSIDRE), the Japanese Institute of Irrigation and Drainage (JIID) and the Shiga Prefectural Government.
3. This type of psychological satisfaction is an important dimension of local agriculture which is described by Murray (1988) with reference to rural Thailand. Murray, a political scientist, noted that local villagers derived satisfaction from solving problems internally, a benefit that was pre-empted by ''top-down'' development programs.
4. An NGO which promotes policies supportive of local irrigation management in Asia and elsewhere is the International Network for Participatory Irrigation Management (www.inpim.org).
5. See, for example, the report by WWF-Europe and the UK-based Land Use Policy Group, Rural Development in an Enlarging European Union (Dwyer *et al.*, 2002).

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